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IDENTIFYING STUDENT'S LEARNING OBSTACLE OF SHIFT EQUILIBRIUM CHEMISTRY BY USING WORKSHEETS

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ABSTRACT

The pupose of study was to identifying student's learning obstacle of shift equilibrium chemistry by using worksheet. Fourty students in eleven grade participated in study. The student worksheet consists of two learning activities. In first stage, students observe the animated videos provided related to factors of shift equilibrium chemistry are pressure, volume and temperature. And second stage, they were answer the questions in worksheet based on observing the animated videos. Data were collected based on student answers on the worksheet. The written responses were analysed to identifying student' learning obstacle. Results indicated that students had difficults explains the reasons for the shift in chemical equilibrium caused by pressure, volume and temperature factors. The obtained results underline that the worksheet was an effective method to identifying student's learning obstacle.

KEYWORD: learning obstacle, shift equilibrium chemistry, students's worksheet.

INTRODUCTION:

Chemical equilibrium has been shown to be one of the most difficult chemistry concepts for students to understand due to its complexity (Hackling and Garnett, 1985; Niaz, 1995; Tyson et al., 1999; Chiu et al., 2002; Park and Park, 2002; Maia and Justi, 2009). Tyson, Treagust, and Bucat (1999) used a two-tier test, coupled with interviews from a case study, to explore students' understanding of what happens when reaction mixtures at equilibrium are disturbed. Three levels of explanation can be used at the secondary level: (i) (the qualitative statement of) Le Chatelier's principle; (ii) the (quantitative) equilibrium law; (iii) the (qualitative) consideration of changes that occur to the rates of the forward and the backward reactions (collision theory). According to the findings, it did not appear that one explanation is better than the other, while language (that is, the use of terms such as 'equilibrium position' or 'equilibrium balance') turned out to be a key factor, causing misinterpretations by students.

In chemistry equilibrium learning students often have difficulty because the concept is abstract. Basically learning difficulty is a problem that causes students can not follow the learning process well and achieve learning objectives. According Brousseau (2002), there are three types of learning difficulties are ontogenical learning obstacle, didactical learning obstacle and epistemology learning obstacle. According to Suryadi (2012), epistemological learning obstacle is a student's learning difficulties caused by the limited understanding of students about the concept. Identification of student learning difficulties can be done by giving the student worksheet. Students' worksheet is a piece of paper containing exercises/tasks-theoretical or practical tasks-for students (Mager., & R. Beach, 2006). The tasks on a worksheet are constructed by teachers and in accordance with the basic competencies and the learning objectives(Patric. & Shibuya,2004; K.D. Kerna,2012). In other words, a worksheet is a resource that can facilitate and direct them in the process of learning. Jensen (2009) defined students' worksheet as a guide for students in the exploration and problem solving. Tasks from teachers included in the students' worksheet are designed in accordance with basic competence and learning objectives specified. Alternatively stated, students' worksheet is the students' instruction manual on the learning process. According to Bonaccorsi, Miller, & Greenbowe (2012), students' worksheet is (a) a sheet of paper used for the preliminary or rough draft of a problem, design, etc, (b) a piece of paper recording work being planned or already in progress, (c) a sheet of paper containing exercises to be completed by a pupil or student. Therefore, this study aims to identify students' learning obstacle on the topic of shifts equilibrium chemistry by using student's worksheets.

Resources and Prosedure:

The participants of study consisted of fourty students in eleven grade senior high school in Indonesia. In this study developed a student worksheet related to the shift of chemical equilibrium influenced by pressure, volume and temperature factor. The student worksheet consists of a table of observations and questions. In first stage, students were given an animated video related to pressure, volume and temperature factors on a chemical equilibrium shift. And then students answer six questions aimed at identifying epistemology of student learning difficulties. This student worksheet has been validated by three experts.

RESULT AND DISCUSSION:

In the first activity, students observed an animated video shifting equilibrium pressure and volume factor on the reaction: N_2O_4 (g) ⇌ $2NO_2$ (g). Furthermore, students recorded the observations based on the animated video. In this activity, students do not experience difficulty when recording observations in the form of color of the initial substance, when balanced and after the pressure is enlarged and the volume decreases. The students then answer three questions related to equilibrium shifts influenced by pressure and volume factors i) how color changes occur when pressure is magnified and volume is smaller than when equilibrium ?; ii) why color changes occur when pressure is magnified? ; iii) Where does the direction of equilibrium shift when the pressure is magnified? Explain!. Here are the results of student learning difficulties analysis based on student answers:

Table 1: Analysis of students' learning difficulties in activities 1 (n=40)

Indicator of student ability	Question 1	Question 2	Question 3
Students are unable to answer or explain correctly	5	26	32
Students are able to explain the reasons correctly	35	14	8
Students are able to predict the direction of chemical equilibrium shift correctly	-	-	40

Based on table 1, it appears that students have difficulty explaining the reasons for the change of color when the pressure is magnified in question 2. This is because students do not understand the submicroscopic changes that occur when the pressure is magnified on the equilibrium system. In question 3, students were able to predict the direction of equilibrium correctly but as many as 32 were unable to explain the reason for the shift in equilibrium based on macroscopic and submicroscopic changes. Students appear not yet able to relate the direction of equilibrium shift with changes in the number of particles (moles) when the pressure is magnified.

In the second activity, the students again observed the animated video of equilibrium shift that was affected by the reaction temperature: N_2O_4 (g) ⇌ $2NO_2$ (g). Similarly, in activity 1, students do not experience difficulties when recording observations of the color of the initial substance, at the time of equilibrium and after the temperature is increased. The students then answer 3 questions: i) how does the color change occur when the temperature is raised compared to when equilibrium ?; ii) why color change occurs when temperature is raised ?; iii) Where does the equilibrium shift when the temperature is raised? Explain!. Here are the results of student learning difficulties analysis based on student answers:

Table 2. Analysis of students' learning difficulties in activities 1 (n=40)

Indicator of student ability	Question 1	Question 2	Question 3
Students are unable to answer or explain correctly	3	21	25
Students are able to explain the reasons correctly	37	19	15
Students are able to predict the direction of chemical equilibrium shift correctly	-	-	40

Based on table 2, students have difficulty explaining the reasons why changes occur when temperatures are raised on the equilibrium system. A total of 21 students can not explain the reasons correctly. Students also have difficulty explaining the reasons for a chemical equilibrium shift when the temperature is raised. Students are unable to relate the enthalpy of a reaction to the direction of a chemical equilibrium shift as the temperature is raised. This result is also in agreement with the study by Demircioglu et al. (2013) investigated first year chemistry students' conceptual understanding of chemical equilibrium. In their findings, students have difficulty explaining whether the endothermic and exothermic reactions have shifted equilibrium when the temperature is raised. Tyson, Treagust, and Bucat (1999) also found that student misinterpretasi of what happens when reaction mixtures at equilibrium are disturbed.

CONCLUSIONS :

The results of this study showed that students experience difficulties when explaining the reasons for a submicroscopic shift in chemical equilibrium when the pressure is magnified, volume decreases and temperature is increased. Students have not been able to relate the change in particle size (mole) and enthalpy of reaction with a shift in chemical equilibrium. Consequently, the obtained results underlined that worksheets are an effective instrument in identifying learning obstacle of scientific concepts. It is suggested to develop worksheets for other chemistry topics and to use them as an alternative to identifying learning obstacle.

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